

A discourse concerning the effects of the great Frost, on Trees and other Plants Anno 1683. drawn from the answers to some Queries sent into divers Countries by Dr. Rob. Plot S.R.S. and from several Observations made at Oxford, by the skilful Botanist Mr. Jacob Bobart.

THE *Cold* now approaching and threatening, easily puts us in mind of the rigour and severity of the last unparallel'd *Winter*; wherein Men, Beasts, Vegetables, and most part of what had any life in it, felt its cruel assaults; some proving able to withstand, and other forced to suffer under it's so unusual and rude a season; which extream *cold* and *frost* happening in our time, gave occasion of taking notice of some of it's extraordinary *effects*, which to enumerate in the several parts of the *Creation*, and discourse of each subject and what operation it had upon each part thereof, might rather employ a large *Volume*, then a discourse, the present intention being only to give some relation of its working among *Vegetables*, and to incite others for the future to the consideration of the *procedure* of the *cold*, and how it operates upon such *bodies*, that thereby we may, being fore-warned, be in some measure prepared for the better *preservation* and *defence* of many things in that nature in other *winters*, the mildest and best whereof, proves troublesome to many *Plants*, though in the general it does kindness to the *Earth*, and it's future product.

In this *rigid season* nothing seemed more surprizing to us, nor more generally known to be true, then the *cleaving* or *splitting* of *Trees* in the time of the hard Frost: To endeavour therefore for what satisfaction could be obtained in this particular the Learned Dr. Plot sent these *Queries* following to several Persons of
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Quality living in different parts of the *Nation*, desiring their opinions and answers, that by comparison, some judgment might be made of so unusual destructive and unwelcome a matter, which especially bent its force against *Oakes*, as a stout enemy assaulting the strongest fort.

1. Whether other *Trees* were split besides *Oakes*?
2. Whether any did *split* with a *noise*?
3. Whether all *Trees* did split towards the same point of the *compass*?
4. Whether the *splitting* were more common in the *trunke* or in the *boughs*?
5. Whether any *Ice* were found since in any of the *Vessels* of the *Wood*?
6. Whether the *Trees* *split*, be any of them *dead*?
7. Whether any of the *Trees* *split* have closed since?
8. Whether they are *split Through*, or only on one side?
9. Whether the *barke* by *splitting* be loosened from the *wood*?
10. Whether the *roots* have been any wayes affected as well as the *Bodies* of the *Trees*?

In answer to the first of these, 'tis too well known that other *Timber-trees* besides *Oakes* were also cleft, as *Elmes* by Mr. *Langley's* house the Minister of *Tamworth*, and *Ashes* of considerable bulk and value, designed for, and capable of diverse uses, as *Windmill-posts*, *Dresser-boards*, and other necessary occasions. Also *Walnut-trees* in diverse places have suffered by this calamity, and proved extreamly cleft; tho indeed it hath been most frequent among *Oakes*, many of which have been divided to great detriment in *England*, some being so rent that a man may see through them, and that many times the *Cracks* came with so great *noise* (which may answer the 2d *Querie*) that as it is related from *Needwood* Forrest they made such a *noise*, that the *Keepers* there thought that the *Deer* were shot by the people of the

the Country, and that in several parts they were heard as loud as *Guns*, some having been cruelly affrighted, especially in the *Evenings* or *Nights* as they have passed within the hearing of this so unexpected and surprizing a noise. Which *rists* or *clefts* were (as in answer to the third *Querie*) not only to the same point of the *Compass*, but sometimes on one side only, sometimes 2 and sometimes 3 and sometimes 4 several places, dividing or quartering the Tree, and sometimes quite through (as the eighth *Querie* seems to examine:) and these *clefts* not only in the *bodies*, but continued into the larger *boughs* and limbs of the Tree, in answer to the forth *Querie*, and sometimes descended into the *superficial roots*, answering to the 10th *Querie*, but not to those very *deep* in the Earth, the Frost though extream, not reaching considerably *deep* comparatively to the roots of Trees, and the hard binding of the Earth being so frozen would not easily admit of compressure, but several shallow roots so knotted and knurled not to be wrought upon with *betle* and *wedges*, are known to be cleft by the *frost*: But it is much to be doubted and suspected whether any such *cloven trees* were so perfectly sound and faithful Timber, if proved by the *Saw* and *Axe*, as they ought to be; for if so, all might equally suffer, the *Air* having impartial access to one as well as the other, but some being taken with this *disease* and other left untouch't, there certainly was some cause or defect in these liable to it, rather than the rest. What it was that might give occasion to some only, might prove a matter worthy of enquiry. A great part of the cause is supposed to be *imperfection* in such a Tree, and that generally from the too large *sap-vessels* and unnatural cavities therein, which some call *Wind shaken*, and some *Lag'd-trees*, the cause whereof remains yet to be examined, whether the shaking of the *Wind* may not, with its great weight and force, taking the whole Tree with its boughs limbs and

and body, having one end firmly fixed in the Earth, at some age or other, as well work wrack and make splintering and stretched pores, passages, cavities and such like in a live and growing Tree, at some time of continuance of its force with its oft repeated beating, twisting, and pressing blasts ; as well as the best chosen Mast of a Ship may suffer damage by the same cause, even to total fraction. By some this is supposed to proceed from *Earthquakes*, but whether or not, is yet to be examined. But the opinion of some seems not to be extravagant who think it to be an original distemper in the Tree, and to proceed from the *soil*, or rather an innate disease from some tho undiscernable imperfection in the *seed* it self, and yet not so much but that they live many years, and grow to great bulk and stature, but are observed to bear *lesser leaves* and *smaller Acornes*, but whether the *soil* be concern'd may be urged ? the Trees about *Oxford* Westward, being generally affected with this disease, and those from the East side prove excellent sound Timber, and the soiles seeming to resemble one another.

But by what means soever this may come, it is certain that some *Trees* are much more sound then other, and that some prove full of inbred diseases and cavities, before they are cut down, which *cavities* and *stretcht vessels* being fill'd with too great a quantity of aqueous and undigested sap, as it were Hydropical (for it is thought that the genuine and natural sap of these our native Trees though undergoing condensation will remain secure and safe, as may be supposed from those that are well and firmly standing) are thereby rendred capable of not only condensation but glaciation also by the continuance and severity of the Aires frigefactive power ; which being sufficiently known to employ more room being Ice than when formerly liquid, might probably cause these *breaches*, and if we consider the expansive motion and spring of the *Aire* included in the

cavities of the *air vessel*, suffering more pressure than they are patient of, from the coagulated and contiguous aqueous parts then congealed, may be induced to suppose these strepitous eruptions to proceed from thence. But whether Mr. *Hobbs* *Hypothesis* will certainly hold, that the swelling is caused by the intrusion of the Air, is somewhat to be doubted.

It need not prove troublesome to any to think the *air* to be able to tear the *Oakes* or other Trees, who shall consider the great force and elastick power thereof, whereof that most excellent and Curious Philosopher of our age *Esq*; *Boyle* hath in his History of Cold set forth several *Experiments* and *Examples*, as Vessels of several kinds of *Mettals*, being made strong on purpose and fill'd with water close stopped and exposed to the *Cold*, which being not capable of withstanding the expansive force of the inclosed *Ice*, have been found cleft and broken; as for instance a strong *Barrel* of a *Gun* close stopped, with water in it, and *frozen*, hath prov'd rent longwaies, and never a cross the *Vessel*, nor *bodies* of the *trees* we here mention: Another time a brass-vessel of a *Cylindrical* form being made not more then 5 inches deep and not 2 diameter fill'd with Water and afterwards *frozen*, in one night lifted off the cover prepared and closely fitted, with a weight of 56 pounds that was laid upon it. *Olearius*, Secretary to the Duke of *Holsteins* Embassy into *Russia*, tells us that in the City of *Mosco* he observed (the *cold* being very intense) the *Earth* to be cleft many yards in length and a foot broad, which according to conjecture was occasioned by the heaving and swelling thereof to enlarge its roome, as here we see *Ice* crackt and cleft considerably long and broad according to its thickness along the ridge or turgid part thereof. And that the *earth* doth so rise when *frozen* is easily made manifest by little *sticks* or *plants* set into the ground against the approaching Winter, which being risen 2 or 3 inches

inches or more according to the *depth* and *strength* of the *frost*, and upon the thaw the Earth sinking to its former station leaves the unfixed Plants with their roots naked above ground, as it were spewed out. And not such moist bodies only, but *Metals*, as *Brass*, *Iron*, &c. have been swelled in the time of being *frozen*, as hath been proved by *Clocks*, *Locks* and other *Instruments*, and become lax and pliant again upon the *Thaw*. Many more *examples* might be easily produced to induce us to the thoughts that the *sap* is not right and genuine in such ill disposed Trees, and that *Ice* might upon due examination be found in any such *bursten* bodies, as we are informed hath been found and observed by some, which may prove somewhat in answer to the 5th *Querie*: and if *Ice*, then pressure, and if pressure, then breaking and explosion.

It may be doubted too, whether some of these *Trees* thus liable to the fury of the *Frost* have not been *Coltie*? a term commonly used among *Timber-Merchants* and by them avoided, which is towards the middle of the *Tree*, among the *Annual Circles* some one is much larger than the rest and the *Sap Vessels* there seem much extended beyond their fellows, and upon cleaving or sawing such a *Tree*, that inclosed or inward heart, part thereof where that Circle is, will slip and drop from the other part oftentimes without any force to divide it, as an Instrument out of a Case or Mould made fit for it.

Some suppose that these *Wind-Shaken* or *Lagd-trees* may be known or nearly guessed at by the outside when growing by the great *Ribbs*, 2, 3, or 4 in a *Tree* from the bottom to the branches, and that they have been affected somewhat considerably with this *disease* before, and perhaps *cleft* (tho not in so great a measure as now) and the *fissures* closed up again, as we see these to do quickly after the *Frost*, insomuch that it is scarce discernable already, and in answer to the 9th *Querie*,
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the *barke* having not been divided from the body, upon coming together again each turn and twist of the grain fitting its place prove fresh and vigorously growing, which may satisfy the 6th and 7th *Queries*, but that ever such *Trees* will prove whole and sound doth scarcely consist with reason or our present thoughts. And this *Calamity* hath not been found in only *Trees* that were fresh and standing, but also in *Trees* cut down, as is affirmed by Mr. *Shish* the *Master-builder* in his *Majesties* Ship-yard at *Deptford*, and from divers others, but notwithstanding it is thought to be only among such diseased *Trees* as are before mentioned.

But it is yet to be questioned whether *Vines* have proved cleft and crackt along the bodies by the same way and reason as *Timber-trees*, which decay is especially to be seen on *Walls* exposed to the *Southern* aspect, so that the *Sun* our accustomed Friend, now proved our great enemy, by *thawing* and *relaxing* the *Sap* every day, and then being *frozen* and made stiff again every night, which often repetition of *bending* and *unbending*, *softening* and *hardening* the vivid spirituous Juice being destroyed, and Day and Night the drought vigorously acting, (the *Sap* being this Year disordered and surprized, not gradually seasoned, even before *Michaelmas* day, and the fresh *Sap* to supply its defects being wholly detained from arising, there then being none or very little exhalations or evaporations arising out of the frozen and bound Earth) these poor slender bodies fill'd only with thin and not viscus *Sap*, have proved as great sufferers as if by amputation they had been deprived of their natural sustenance; for if they could have none from the Earth, and their own true *juice* mortified, and it be certain that *omne siccum appetit humidum*, it will follow that such branches will by the constancy and continuance of such severity (the Day being as bad as the Night) prove as dry as sticks cut off long before : where-
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as those of this kind and other sorts also growing in more shadowie parts and undergoing but one change have remained in good condition, especially among *Red Grapes*, which seem much more hardy then *White* ones.

We see other *Wall-fruits* on the same position as *Apricocks*, *Peaches*, *Plums*, *Cherries*, &c. not at all injur'd or prejudiced by the *weather*, which are of a more clammy viscous juice: These we see run sometimes and give gum; but the *Leakage* of *Vines* is as thin as *Water*, which different *Juices* and *Saps* in other *Trees* and the degrees thereof, as well those with deciduous leaves as *ever-greenes*, may prove some cause of the weakness and decay of some, whilst that of another sort standing by remains fresh and vigorous, only stagnated, sedate, and quiet, waiting for the benign *Suns* beames to actuate, lenifie, and put its spirits in motion, and its comfortable refreshment to arise in due season; And perhaps according to the degree of this qualification in *Trees* and *Plants* (some being much more sluggish then other) may be the cause of their earlier or later *germination*. But to rightly examine and consider the several and distinct *Juices* of *Trees*, every one certainly differing from each other, and the alteration so easily made by what *salts* or *spirit* each rejoices in, and their several commixtures, and the many *Coates*, *Passages*, *Streyners*, *Vessels*, and the different procedure of each, would prove a large task, though much facilitated by the Learned *Malpighius*, whose great curiosity hath been shewed on this subject.

It is easily observed that in dry, Mountainous, Rocky, and barren Plantations, where *Trees*, *Greens*, and other *Plants* having been sparingly fed, and not pampered with such *Luxuriance* and freeness of *Sap*, as in the *Valleys*, and richer *Soils*; have escaped tolerably well, and by this which in other *Years* proves their *poverty* and *disease*, now make them insult over those growing in the *fatter Valleys* proportional to the height of the *Hills* they grow on.

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We may observe *Trees* all the *Winter* while the *sap* remains condensed to be safe and well, but if a flattering too early glance happens in the *Spring* to set their *parts* in *action*, and the *juices* to become *fluid*, and a sudden mutation of that *warmth* to a fresh return of *Winter*, (which too frequently happens in *England*) that then we have not only our hopes of that years *fruits* blasted, but even the *passages* in the *branches* and *boughs* stopped, and the crude *sap* settling commonly called *bliting* (tho there be many causes of the effects which go under that notion) becomes a *disease* in *Trees* equal to that of *Child-blanes* in juvenile blood, which sometimes takes whole *trees*, and sometimes *branches* only; Hence is supposed the decay of the *Glastenbury Thorne*, whose arising time being between *Michaelmas* and *Christmas* being sap-pily prepared by the beginning of the hard *Frost*, which hath almost affrighted it out of its life.

Some *Trees* and *Shrubs* seem to have their Vessels and passages so streightened and 'as it were shrunk with *cold*, that they appear equal to a human body *sinew-shrunk* or *paralytick*, that is not without much trouble able to move or bear his decaying limbs; Thus we see *Trees* with their *barke* shriveled, with their passages half stopt, whose *sap* now only squeezing and difficultly passing, hath much ado to force its way through the dried and narrow pores and passages of the *body* and *branches*, and sometimes this distemper is so prevalent that whole *branches* of a Tree are kill'd when the other part is indifferent well.

Some *Liquids* such as *Essential Oyles* do rather shrink than encrease being *frozen*, and *Empereumatical Oyles* will hardly freeze but wast, which considerations may introduce the thoughts of what some *Trees* are made of, or do abound in, as *Firrs*, *Pines*, &c. which are capable of enduring the cold of *Normay* and other Countries.

These and many other such *considerations* here, but
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some whereof hinted, may require and deserve farther and more particular examination and improvement, but at present having mentioned these things in general some or other hereof may perhaps suit with, and prove applicable to some or other of these particulars hereafter to be mentioned.

What *Timber-trees* have suffered, are above specified, but diverse other of our native Trees and Shrubs have scarcely proved able to withstand the force of so rude an enemy. *Yew* and *Holly* (things whose tenderness was never suspected) were in some places quite kill'd, and in many places so discouraged loosing their leaves, and blemishing the bark, that it is to be feared they will never take on their pristine Splendour and Verdure. The *Furze* in many places quite kill'd, and in most places cut down and spring again, but often the resurrection in vain expected; *Common Broome* proves a degree hardier; In some places the Sunny side of a *Juniper* bush proves *scorch't* between *Sun* and *Cold*, but that proves one of the most hardy of our native Greens; so that it is hard to say what is Winter-prooffe, even among our Natives, except *Box* and *Ivy* which stand in defiance of all.

And after this to look into the *Gardens* (which generally are *Nurseries* of *Exoticks*, and from *warm Countries*) and to think how great destruction hath there happened is directly *renovare dolores*, and this *Calamity* taking off the especial beauty thereof hath principally bent its force against *Winter-greenes*, such as *Alaternus* (commonly known by the name of *Phillurea*) and the true *Phillurea* also, which are generally kill'd, though some upon cutting down spring again. Also common *Bayes* seen in most places to be kill'd down, and *Lawrell* seldom proving impatient, is in some places kill'd, in some places half dead; *Rosmary*, *Laurustine*, *Halimus*, *Arbutus*, *White Jasmine*, and other which seldom fail, are generally kill'd through the whole *Country*. But of

all these and other such like, in *Mountainous* and *dry places* (as was before observed) there is brisk life and verdure yet remaining though rarely to be met with, but however enough to retain the several *species* among us. But if for the future in such times of *extremity* the superficies of the Ground, and bodies of such things here recited and *Fig-trees*, were well covered with *strawy matter* to keep off the *Frost*, it might so preserve them as to spring out plentifully the Spring following, though their whole *tops* being too large and high, and thereby incapable of such covering, might loose their present leaves and beauty, which might from such respringing be easily repaired, and prove much more satisfactory, then to begin the world anew, as we are generally forc't to do for *Cypresses*, which were us'd to be excellent *Ornaments* both in Summer and Winter, now it proving a very rare thing to see one well alive ; In some places there appears some lingering life, but scarcely sufficient to recover the whole, but in most places are quite dead, that have faced 40, 50, or 60 *Winters* before ; After some *Winters* they appear somewhat scorch't and ruffet, upon which Esq; *Evelyn* directs the beating and thrashing them with a good tough Hazle wand, or such like, to ease them of their dead leafy parts, and admit the refreshing Air to the inward parts and branches , but this year their disease is beyond the power of such a remedy, but from Seed they will within few years be repaired.

Also among those with *deciduous leaves*, divers have been sufferers, as *Arbor-Jude*, young *Plane trees*, though those of considerable stature have pretty well escaped, *Paliurus*, The *Aleppo* Ash, in some places the *Locust* Tree, and in most hedges the great common *Bramble*, and some other , which upon cutting do some or most of them spring again.

But such *Greens* also as we receive from, and are the
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glory of warmer *Countries*, and very rare, curious and pleasant with us, such as *Oranges*, *Lemons*, *Myrtles*, *Pomegranates*, the perfuming *Jasmines*, and divers other rarities which are usually kept in *Pots* and *Cases* for the convenience of removing them into *Green-houses* and *conservatories*, not being able to endure our milder winters, have in many places extreamly suffered, especially in houses of weaker defence, but where the skill, care and due management of their *Keepers* have met with the convenience of good warm Houses, with keeping constant *fires* (which is a matter to be regulated with great discretion) according to the proportion of which combining qualifications, the *Plants* have escaped, as in some places most of them are well, in some places half, and in some places all dead ; but with additional care and secure keeping, as the enemy encreaseth, they even the most tender are to be kept and produced in the *spring* to our great satisfaction and pleasure.

But indeed in the *Spring*, being flattered with some warme *glances* and refreshing *daies*, to the great danger, many are apt to expose their *choise greens*, which upon a suddain change to its former *Cold*, with sharp *Eastern* winds, proves more pernicious to such *strangers* as well abroad as out of houses, then all the former *Winter*, and seems to finish the destruction of what the former *Cold* hath spared, a matter too frequently seen among us, we enjoying no certain steady Summer till after the *solstice* ; But these tender *Exoticks* loosing their leaves having received detriment, with their tops shriveled and the like, are oftentimes not capable of enduring the interposing scorching heat of the *Sun*, which sometimes happens by fits in the *Spring*, when the prudence and care of the *Gardener* is especially tried, gradually to help and recover his *sick Patients*, sometimes by due trimming, earthing with fresh sustenance, loosening the strait bound earth, and sometimes with the help of a warm bed, and

gentle watering and shadowing and the like , patiently and carefully waiting till the return of the bounty of the *Heavens* to help his *endeavors*.

Among *Plants*, *Herbs*, and *Flowers*, there hath been great destruction also, and many of common use, as most of the *Artichokes* of *England*, and winter *Coleflowers*, *Sage*, *Tyme*, *Maſtick*, *Lavender*, *Laven-Cotton*, and divers other were generally kill'd, except ſuch as happened to be new planted that year, and ſo low that they had the enjoyment of the kind covering of a little *Snow*, which proves the moſt natural, *feeding*, and *warm covering*, of any thing to be mentioned; but what peeped its head above it ſeemed in great danger of being kill'd; And as we may ſee in the *Corn-fields*, that thoſe ſides of the *Lands* of *Corn* facing the *South* where the *Snow* was melted and the *Corn* deprived of its covering, the want proved deadly, and in many places Husbandmen were forced to begin again in the *Spring* to plough and ſow other *Grain*; which may eaſily teach us rather to heap *Snow* upon our *Herbs*, and *Flowers*, then fancy it a cold unkind enemy. But in the *Flower-Garden* eſpecial obſervance ought to be taken that the *Choifer Roots* of the *Aſian Ranunculi*, *Aulmoneys*, Tender *Narciſſi* and divers other of the like tenderneſs and ſtrangers to ſuch entertainments as our *Northern Countries* afford, that if hard *Froſt* ſhould happen upon the *Thaw* and melting of ſuch covering, ſhould be ſecurely covered and kept from the *Froſt* if poſſible, till the too *frigid moiſture* of the *Earth* be digeſted, which would prove pernicious even to the *death* and *rottenneſs* of many ſuch *Roots* and *Plants*.

But after all this repetition of *ſorrows* we are to comfort our ſelves that ſuch *deſtruction* and *calamity* happens but very rarely, the like having not been known in the memory of man, if ever before; And that with due care and obſervance the growing *cold* might be kept off from ſuch things as are proved to be impatient of it; which
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are not all *Greens* in our *Gardens*, some being able to endure all the cold that ever came, as *Firrs*, *Pines* of divers sorts, *Cedars* of *Libanus* and *Virginia*, (though that of *Barmoodes* proves tender). *Arbor vitæ*, all the *Saxius*, whereof the upright or *Berry-bearing*, is the best *Succedaneum* to *Cypress*, capable of finer cutting into *Pyramids* or other figures, or hedges, 6 or 8 foot high, and is one of the best of the *Tonfile Shrubs*; also the *Pyracantha* proves exceeding hardy, and makes good *hedges*. Divers others might be mentioned, and with additional care to help the weaker, some whereof are formerly spoken of, which perhaps may not feel such severity in our time nor many years after, we may not prove so *pusilanimous* as to be discouraged, but remain satisfied with the hopes that we may enjoy the pleasure and refreshing satisfaction in *Gardens* as heretofore.
